Energy-Efficient Glass Melting — Next Generation Melter

Oxy-gas-fired submerged combustion melter offers simpler, improved performance

For the last 100 years, the domestic glass industry has used the same basic equipment for melting glass on an industrial scale. Manufacturers employ refractory-lined furnaces of various sizes, fired with air or oxygen and with natural gas or oil as fuel. A few of these furnaces are powered electrically, usually for costly compositions. Over time, incremental changes in combustion systems, regenerators, refractory, batch handling, the use of oxygen instead of air, and other advancements have extended furnace life, decreased the size of furnaces, and improved energy efficiency. None of these improvements, however, has eliminated dependence on these large, costly melters, which burden the glass industry with high capital and energy costs, and reduce competitiveness against growing competition from foreign producers and alternative materials.

A next generation melting system based on an oxy-gas-fired submerged combustion melter would offer every performance characteristic that current melters offer plus decreased operating and capital costs, energy use, and emissions, with a simple design and high reliability. These new melters could be used immediately in applications requiring little glass refining, or integrated with future advancements in refining technology.

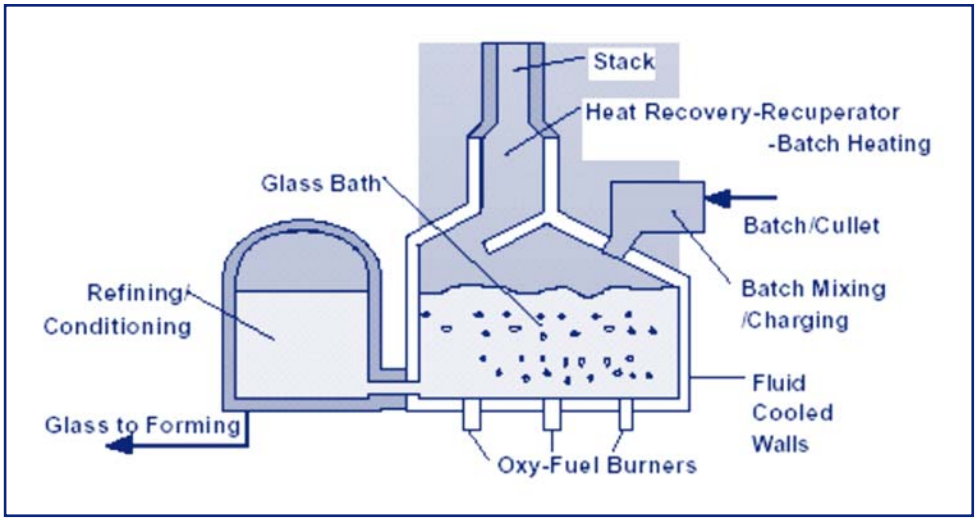

Figure 1 – Schematic of Submerged Combustion Melting Process

Benefits

- *Up to 23 percent energy savings*
- *Significant reduction in capital costs*
- *Up to 50-percent reduction in NO_x emissions (decreased fuel use and peak-flame temperatures)*
- *Increased operational efficiency*
- *Up to 80-percent reduction in refractory usage*

Applications

The glass industry, which as a whole uses the same general approach for glass production, would benefit from next generation technology. Industrial adoption of this new technology has the potential for higher efficiency, lower capital cost, and increased simplicity.

Project Description

Goal: To design, demonstrate, and validate the melting stage of a low capital-cost, energy-efficient next generation melting system for the glass industry.

The need for new glass melting technology has led to the formation of an unprecedented consortium including the Gas Technology Institute, six glass companies, and several suppliers. This team will attempt to deliver submerged combustion melting (SCM) to the glass melting industry. In SCM, an air-fuel or oxygen-fuel mixture is injected directly into a pool of hot melt. The combustion gases bubble through the bath, creating a high-heat transfer rate to the bath material and turbulent mixing. Melted material with a uniform product composition can then drain from a tap near the bottom of the bath.

The new technique yields intense combustion, direct-contact heat transfer (combustion products bubble through the melt), and a high rate of heat transfer and rapid mass transfer (high thermal efficiency and reduced melter size). SCM is a simple, robust, and reliable technique which melts and mixes in a single stage while remaining compatible with other stages of a segmented glass melting system (charging, refining, heat recovery). Batch handling systems can be simple and inexpensive because the melter is tolerant of a wide range in batch and cullet size, can accept multiple feeds, and does not require perfect feed blending.

Progress & Milestones

- The project started in September 2003.
- In the first year, project partners will model, design, and procure equipment for a pilot-scale melter.
- In the second year, the team will fabricate the pilot-scale melter, conduct tests, and analyze results.
- In the third and final year, the team will make melter modifications, perform further testing and analysis, and move toward commercialization.

Commercialization

After this project, the submerged combustion melter will be ready to move toward commercial production of fiberglass and other glasses needing little or no refining. For other glasses, additional research will be required to develop and demonstrate a rapid refining process to couple to the submerged combustion melter. The glass companies involved in the project represent approximately 50 percent of U.S. glass melting capacity, and have indicated a strong willingness to implement the technology upon successful demonstration of the technology. Project results will be disseminated at industry conferences, through print media and other mechanisms. Other U.S. glass companies will be able to license the technology from the Gas Technology Institute.

Project Partners

Gas Technology Institute, Des Plaines, IL

Corning Incorporated, Corning, NY

PPG Industries Inc., Pittsburgh, PA

Owens Corning, Granville, OH

Schott Glass Technologies, Inc. Duryea, PA

Johns Manville, Littleton, CO

CertainTeed Corporation Blue Bell, PA

Fluent, Inc., Lebanon, NH

A.C. Leadbetter and Son, Inc. Toledo, OH

Praxair, Inc., Danbury, CT

Combustion Tec / Eclipse Rockford, IL

NYSERDA, Albany, NY

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January 2004